SUSTAINABLE AGRICULTURE

in the Yukon

An environmentally sound solution

A curriculum resource to be used in the classroom—grades 8 to 12.
Complete with information and activities.

August 1993

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An environmentally sound solution

This resource was produced by Diane Simpson for the Agriculture Branch, Department of Renewable Resources, Government of the Yukon, 1993.

Additional materials may be obtained from the Agriculture Branch, which has a large collection of information and education resource material, including more than 500 pamphlets, numerous videos and a small, but growing, library for public use.

Illustrations by Duma Alwarid, Whitehorse, Yukon

To the teacher

The purpose of this resource is to help students look critically at sustainable agriculture in the Yukon. It is designed to be adapted to your science, geography, environmental or social studies curriculum. Grades 8 to 12 can benefit from these materials.

This resource has two parts. The first part is a fun, yet informative look at agriculture in the Yukon. This section is to be photocopied and read by students (to save time and paper, photocopy one set for groups of 3 students), or you may put the set onto overhead sheets and share it with the whole class.

The second part provides a role drama and activities for the students. These activities help students apply the knowledge gained in part one.

This booklet is designed so that it is enjoyable for you and your students to read. All the information about sustainable agriculture in the Yukon is contained in one booklet and the activities provided are easy to follow.

This booklet opens the door into agriculture, sustainability, and local and global environmental issues. It may spark areas of interest for you and your students to explore further. Additional educational materials may be obtained from the Agriculture Branch to assist in your research.

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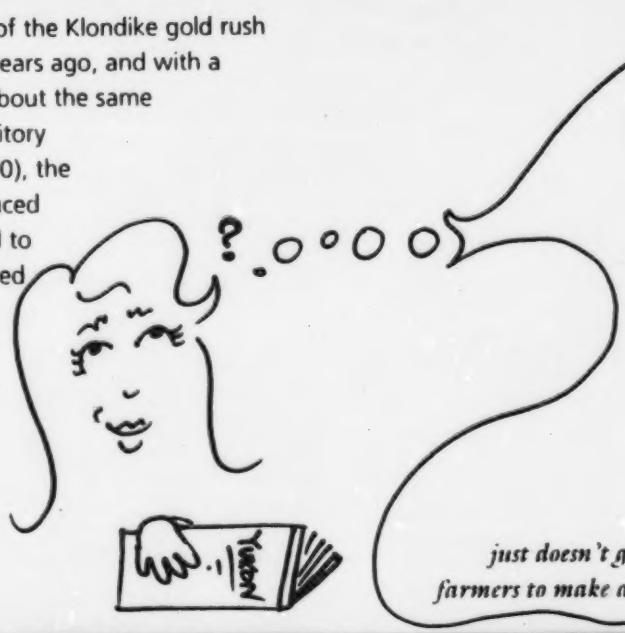
1 Agriculture in the Yukon: it is expanding

1.

At the peak of the Klondike gold rush almost 100 years ago, and with a population about the same as in the territory today (30,000), the Yukon produced enough food to essentially feed itself.



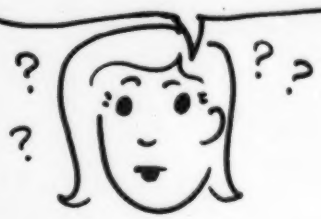
Wow. I wonder why we don't have that much agriculture in the Yukon today? Our family gets all its food from the supermarket and most of that food is brought in from Alberta, B.C. or the United States. Well, I guess food just doesn't grow well enough up here for farmers to make a profit.

2.

So you think agriculture isn't viable in the Yukon? At the end of the gold rush, the Yukon's initial agriculture did disappear with the declining population, and the advent of modern transportation systems. But today, agriculture is reappearing. Since the 70s the Yukon has seen a major resurgence in interest in agriculture. And because agriculture is expanding in the territory, the Yukon government wants to make sure the agriculture-food industry develops in the right way. The government wants to make sure we don't make the same mistakes as in other regions of Canada.

3.

What do you mean by mistakes?



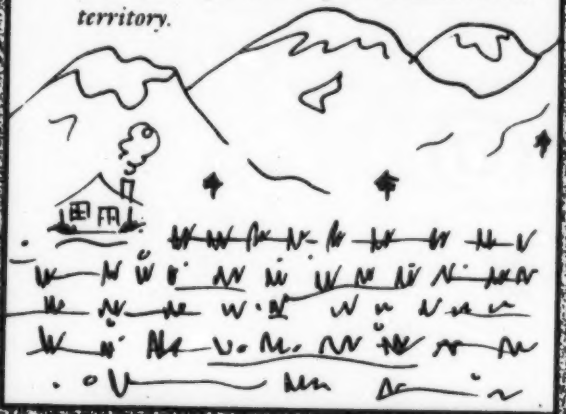
Although modern farming methods have made it possible for us to grow far more food than we have done in the past, it has caused some problems for the environment and our soils. A decline in the quality and productivity of agricultural soils is a serious problem in Canada today. We have lost 60% of our topsoil in the last 30 years. There will always be some topsoil lost when farming an area, but we can reduce this amount by incorporating certain practices when we farm.

In the Yukon we have the opportunity to avoid soil degradation by proper soil conservation practices. The Yukon government is encouraging farmers to manage our land and soil properly by replenishing the soils. This will ensure that our farms remain productive for future generations. And with everyone worrying about the environment these days, minimizing the effects of agriculture on the environment is also an aspect of what the Yukon government wants farmers to do.

Farming that replenishes the soil, and has a minimal impact on the natural environment is called sustainable agriculture. So let's explore agriculture in the Yukon. But you are going to have to be ready to view agriculture differently, OK?

2 Taking a closer look: How big is the Yukon's agriculture-food business?

❶ *When we think about agriculture we usually don't think about the Yukon; but there is farming here and people are making a living at it. There are 137 farms that are part of the agriculture-food business in the territory.*



❷ Farmland in the Yukon

There are 5,263 hectares (13,000 acres) of farmland in production or under development in the Yukon.

There are 3,603 hectares (8,900 acres) in livestock or crop production.

❸ An integral part

Hobby farms, small rural acreages and home gardens are also an integral part of the food production system in the Yukon.

❹ The agricultural scene in the Yukon

Typically, a Yukon farm might be located 20 to 50 kilometres outside of Dawson City or Whitehorse and on average have about 50 hectares. Throughout the Territory, 20 hectares of land are in vegetable production with an additional 3700 square meters of greenhouse production. A good deal of this is for home consumption.

❺ Yukon farm profile

- average farm size is 54.65 hectares (135 acres)
- average sales in 1991 were $12,500
- 88% of farms operators are intending to further develop their holding in the next 3 to 5 years
- 15% of farmers are full-time operators
- 68 farms report hiring seasonal labour
- livestock account for 53% of total sales
- reported sales for 1991 were $1.7 million
- 71% of agriculture production occurs in the Whitehorse region
- field crops, horticulture and game farming each account for 10 to 15% of total farm sales

3 Benefits of agriculture: creating more stability through agriculture

❶

So what are the benefits of developing agriculture in the Yukon?

Hey! Agriculture needs to be wherever people are living. Growing our own food is important. To be completely self-reliant and self-sufficient agriculturally gives the community a certain stability. It may not make us rich, but it will allow us to be independent.

❷

Are there problems with dependency?

Do we always want to be dependent on bringing food up from the south? What happens if for some unexpected reason we couldn't transport food to the Yukon? What happens if the cost of transporting food becomes too costly due to rising fuel costs?

There are four main problems with relying on imported food:

- increased vulnerability to the disruption of the food supply
- energy inefficiency and costliness (transportation costs)
- less nutritious food (for example, vine-ripened tomatoes can have 25-30% more vitamin C compared to those ripened with ethylene gas)
- produce shipped from the south is of an inferior quality to Yukon-produced speciality greenhouse goods and fresh vegetables in season

❸

Our produce in the Yukon is travel weary

By the time most of our foodstuffs arrive here from the south, they are travel-weary and lack the appeal of local fresh produce. Local farmers can tap into the demand for fresh produce.

Consumers are often willing to pay more for fresh produce. How about you? In the future when you are shopping for produce, do you think you will be willing to pay more for fresh, Yukon-grown products?

❹

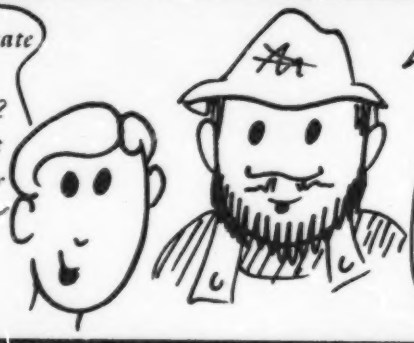
Becoming a multi-based economy

Yukon-produced agricultural products will not only reduce the amount of imported foodstuffs, they will help the Yukon become a multi-based economy.

4 Growing conditions: farmers adapt to Yukon growing conditions

❶

But what about the climate and poor growing conditions in the Yukon? Everyone knows we don't have a very long summer for growing.



Well you're right, we do have a short growing season. It does vary from place to place, but in the Yukon we average a 100-day growing season, with about 70-90 frost free days. So producing many crops is a real challenge for farmers. But they do it.

❷

We are not frost free for long

The frost free period is the period between the last frost in spring and the first frost in the fall.

❸

Listen to this farmer—her family makes a living at farming in the Yukon

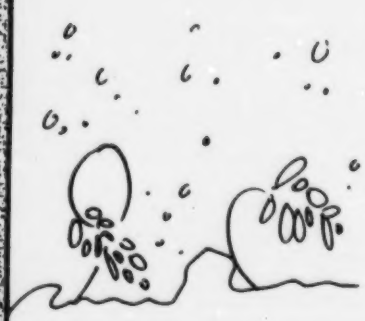
Yes! We make a living on agriculture and we can compete with outside producers. It is hard work, but if you want it and believe in it you can have agriculture anywhere. They farm in Siberia and Alaska and their soil and climate conditions are similar to the Yukon. We just have to be a bit more innovative with our farming practices to make it work.

❹

Plants love our long summer days

It can't be denied that any agricultural operation in the Yukon will have to contend with less than idyllic climatic circumstances. However, the northern location also results in very long days in the summer and high numbers of sunshine hours, which can compensate for the generally lower soil temperature and shorter growing season.

❺ Winter stress—the plants have it too



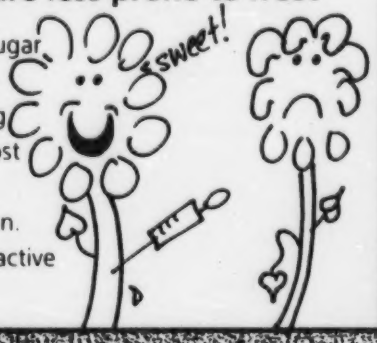
Winter stress can make it very difficult for plants adapted to southern growing conditions to survive here. Plants that are adapted to harsh climatic conditions are selected and grown here.

❻ Growing in cold weather is not easy

Yukon crops are particularly vulnerable to losses due to weather. Because of the cold weather in the Yukon, farmers need to grow plants that are climatically adapted to the Yukon. Over the last 5 to 10 years the Yukon government has helped farmers identify the most appropriate farming practices and the most viable crops for the Yukon's tough climatic conditions. And that means anything from hay to tomatoes!

❼ Healthy plants are less prone to frost

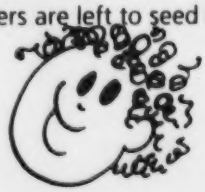
Crops with a higher sugar content have a lower freezing point, making them less prone to frost damage—and that's important in the Yukon. They are also less attractive to insects.



❽ It's dry out there

What about the dry soils in the Yukon? Dry soil conditions are one thing the farmer must cope with in the Yukon. Low precipitation and a process called "sublimation" result in conditions the farmer must overcome.

When spring arrives in the Yukon, even the heaviest snowpacks seem to vanish into "thin air". That is exactly what happens in the process known as sublimation. The snow evaporates into the air instead of melting into runoff. What is left is a soil that quickly dries out from sun and wind. And farmers are left to seed into a dry seedbed.



Seeds need moisture to grow—so what do farmers do?

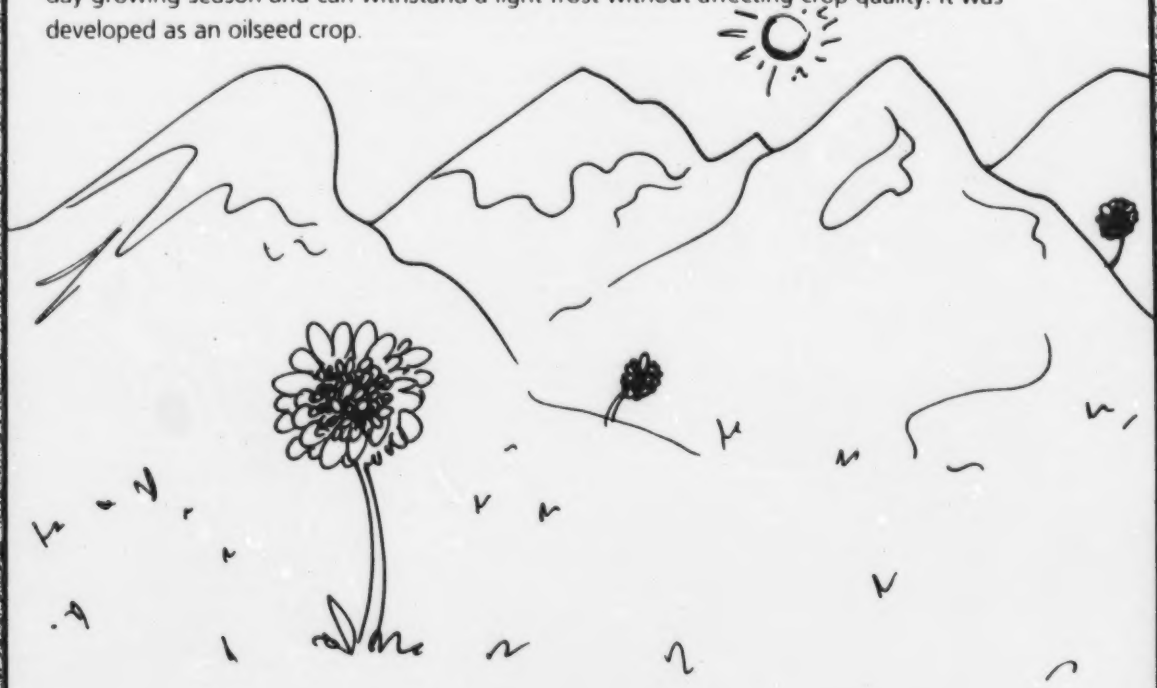
The farmer can avoid problems by seeding in the fall. The fall seeding is done after plant growth has stopped but before the soil freezes up. This allows the seed to lie dormant over winter and to germinate earlier in the following spring when moisture levels are highest. However, the most suitable practice is to grow a permanent cover crop to maintain moisture in the soil.

⑨ Great ideas for the cold

There are lots of great ideas for northern climatic conditions. Here is one you may not have heard of before.

Researchers at Agriculture Canada are developing a new sunflower crop known as sunola. Sunola is a true sunflower.

The new sunflower grows about one meter high and can survive brief dry spells. It needs a 100-day growing season and can withstand a light frost without affecting crop quality. It was developed as an oilseed crop.



⑩ It's all in the way you choose your seeds

Local producers claim that collecting your own seed source from Yukon-grown crops help the farmer develop plants that are better-adapted to local climate and sunlight conditions.

This is basically how farmers and researchers select the seeds that will grow best in Yukon climatic and soil conditions:

- First, they monitor growth characteristics over the whole season.
- Then they select for the specific characteristics they desire. For example, if they want frost resistance, then they look for plants that were most resistant to frost.
- Finally, when they have chosen the desired plants, they save the seeds from those plants to grow the next year.

5 What grows here: the Yukon produces a variety of products

1.

Growing happens all over the Yukon

The Yukon is capable of producing a wide variety of agricultural products. Vegetables, forages, grains and livestock have been successfully grown and produced in locations ranging from Dawson, Mayo and Haines Junction to Whitehorse. Although the areas with the best climate for crop production are Mayo and Dawson, most of the farming is located around Whitehorse.

2.

From honey to bean sprouts—it's all here

Yukon agriculture-food ventures include:

- market gardening (potatoes and vegetables)
- cereals (oats, wheat and barley)
- hay
- honey
- grass sod
- bean sprouts
- production of seed from native grasses
- game farming (elk, reindeer, musk oxen, bison)
- wild and cultivated berry processing.

3.

What domestic livestock do we have in the Yukon?

- horses
- beef cattle
- dairy cattle
- hens and chickens
- hogs
- sheep
- goats
- game animals.

4.

3,500 hectares —wow!

It is estimated that about 3,500 hectares of land are under cultivation, most of which is in forage production. Grass hay (mainly bromegrass) and green feed oats and barley are sold as feed for horses used in the outfitting business and to supply a half dozen elk farms in the Whitehorse area.

forage: horse and cattle feed

5. **Game farms**

In 1990, the Yukon had 6 to 8 game farm operations. Elk, bison and reindeer are produced for their meat, antler velvet and breeding purposes.

6. **Bees are buzzing in the Yukon too**

There is an active beekeeping society in the Yukon. There are approximately 40 beekeepers and 110 colonies of bees. And that's agriculture too!

7. **Mushrooms—what next?**

It could be mushroom farms in the Yukon. Studies show that the Yukon could produce mushrooms. We eat approximately 2.27 kg. (5 lbs.) per person per year so that's 56,818 kg. (125,000 lbs.) of mushrooms eaten a year in the Yukon. And mushrooms cost approximately $7.70 a kg. ($3.50 a lb.), so that's a lot of money. But don't forget about the costs to the farmer. Depending on the degree of mechanization, costs could range from $46 to $148 per square meter ($14 to $45 per square foot.) But fresh mushrooms—that may be worth it!

8. **Locally-produced meat**

A site is being selected in the Yukon for an abattoir. We may be buying locally-produced meat sooner than we think.

6 Critiquing agriculture: some say it can't be done

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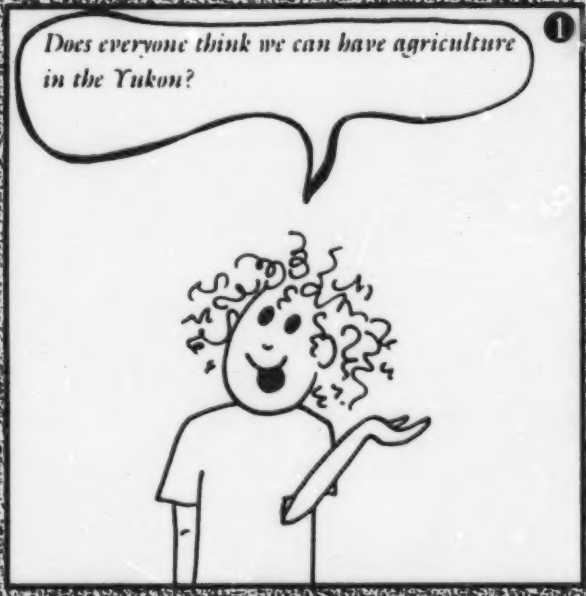

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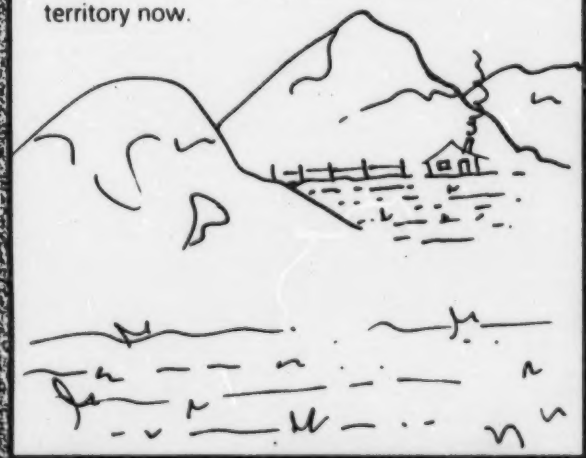
Agriculture is a controversial topic

This is a controversial topic in the Yukon. There are no clear-cut answers. Although there are people making a living at farming, some say we can't support large industrial farms, only the small-scale farming like we have in the territory now.



❸

Some say it can't be done

Some researchers say that we can't have successful commercial farming in the Yukon because:

- markets are too limited for farmers to make a profit
- the physical environment of the Yukon is not suitable for farming
- it is too difficult to compete with the large-scale, highly mechanized farming that happens in southern Canada
- the capital investment (machinery, buildings and irrigation equipment) is too large for the low yields we get
- the costs of labour and transportation are much too high
- there are no grading, processing or storing facilities in the Yukon.

It costs a lot to be a farmer

❹

It costs a farmer on average $1,235 per hectare ($500.00 per acre) to clear, pile, break, seed and fertilize. A farmer who has 40 hectares (100 acres) may spend $50,000 before making any money on his/her farm crop. And the farmers' costs are passed on to the consumer.

How about livestock?

❺

Is it financially viable to produce animals?

Well, a farmer can produce just as many pigs, cows and poultry up here but some say we can't compete with the farmers down south. Some say:

- it costs too much to produce meat up here and so it is cheaper to buy meat from down south
- it costs too much to build barns for the animals.

Yukon farmers must compete

❻

Yukon farmers must be able to produce quality food and compete with outside producers in terms of the cost of their product. Beating the cost could be difficult, but beating the quality should be easy.

Supporting farmers

❼

Does your family support our local farmers? One way of supporting local farmers is buying the locally-produced food at the farmers' market in Whitehorse and other communities.

GROWN IN THE YUKON

7 Canada-Yukon Agreement on the Agriculture-Food Component of the Green Plan: An agreement that supports the environment

A new vision begins

You said I was going to have to think about agriculture differently—that the new way of practicing agriculture incorporates soil enhancement programs and minimizes farming's impact on the environment.

Yes, that's right. A movement is growing that develops a new vision of agriculture. Conventional farming techniques are sometimes viewed as harmful to our water, plant, land and wildlife resources. They may be viewed as detrimental to human and animal health. The new agriculture will be a way of practicing agriculture that is based on ecological principles. Although some people have been thinking and practicing farming in the "new way" for quite a while, the majority of farmers follow a more conventional method of agriculture.

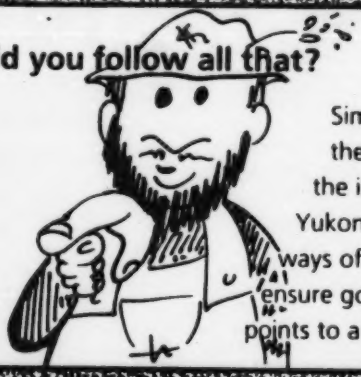
Canada's Green Plan is an action plan initiated by the federal government for sustainable development. This is development that tries to integrate both the economic and environmental challenges of the future. Canada's Green Plan has many sections and one of those is on agriculture. This is called the Green Plan's Sustainable Agriculture Initiative. Over the next five years, the Green Plan's Sustainable Agriculture Initiative will provide $170 million all over Canada to help the agriculture-food industry make the transition to a new environmentally sound way of practising agriculture, called sustainable agriculture.

❷

An agreement to help the environment

But it doesn't stop there. The governments of Canada and the Yukon have agreed to work together to achieve an environmentally sustainable agriculture-food sector for the Yukon. And that is how we finally get a Canada-Yukon Agreement on the Agriculture-Food Component of the Green Plan.

Did you follow all that?



❸

Simply, the government of the Yukon has an agreement with the federal government to develop a number ways to minimize the impact of agriculture on the natural environment in the Yukon. This agreement also encourages farmers to practise new ways of farming that replenish and conserve soils in the Yukon to ensure good growing soils in the future. Everything in this agreement points to a new way of farming called sustainable agriculture.

❹

Being pro-active—*now that's cool*

Members of the Yukon's agriculture-food industry support a pro-active approach to addressing environmental concerns. They plan to adopt new approaches that protect the natural environment. The Canada-Yukon agreement encourages industry and government to work together on six broad but related environmental issues:

- strategies to address water quality
- strategies to sustain soil and land resources
- strategies to protect wildlife habitat
- strategies to address pollution and waste management
- strategies to enhance public awareness
- on-farm demonstrations and applied research.

❺

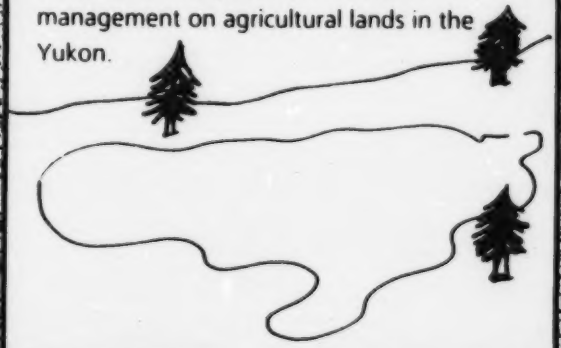
When are we starting?

The Canada-Yukon Agreement on the Agriculture-Food Component of the Green Plan came into effect on April 1, 1993.

❻

What are those key concerns?

The key areas of concern in the Canada-Yukon agreement are: water quality, soil conservation, wildlife habitat/agriculture interaction, and pollution and waste management on agricultural lands in the Yukon.



8 Sustainability: it's one of the most talked about concepts in years

Let's take a look at what sustainable agriculture means

In the Canada-Yukon Agriculture-Food Green Plan Agreement the Government of the Yukon states it is committed to sustainable agriculture. But I'm still a bit confused: what exactly is sustainable agriculture?

Sustainability—it comes from deep thinking

What we did on our farms since the 50s may not be appropriate any more. Serious questions are being raised about how Canada's agricultural lands have been managed. There are problems of erosion of valuable topsoils, the expansion of cities onto prime agricultural land, consumer fears of pesticide contamination, excessive dependence on monoculture, the destruction of wildlife species and habitat, and a multitude of other factors.

To farm successfully in the 1990s we will need to adopt new principles and practices to ensure that we keep farming ecologically and economically sound. Sustainable agriculture is a system of farming that offers us ways of farming that do not harm the environment.

Sustainable agriculture is rooted in a set of values that reflects an awareness of ecological, political, economic and social realities. It emphasizes agricultural practices that work with nature to conserve resources and minimize waste and environmental damage. This system is based on self-reliance, encouraging less dependence on imported foods. And it does this while maintaining and improving farm profitability.

Sustainable agriculture systems are designed to take into account soil nutrient and water cycles, energy flows, beneficial soil organisms, natural pest controls, and the humane treatment of animals. Sustainable systems also aim to produce nutritious and uncontaminated products that won't harm human and livestock health.

In a nutshell

Sustainable agriculture needs to be ecologically sound, economically viable, socially just, and humane.

Did you know that...

...conventional agriculture produces four times or more the yield per acre than sustainable agriculture, but may require up to one hundred times the energy input.

Change isn't easy

For the farmer who uses conventional methods it takes time to switch to a sustainable system. It involves some risks, some temporary loss of productivity, and a new way of thinking.

Everything integrates—it's ecologically sound

In a redesigned sustainable agricultural system the farmer will pay more attention to balance and feedback. They will respect diversity, cycles of nature and its limits. Efforts will be directed towards more complex crop rotations, multiple cropping, companion planting, and inter-cropping. An ecological farm will be smaller and mixed with marketing aimed at the local population. The resources to run the farm will come from the farm or be obtained locally.

We can do it too

We can begin sustainability in our own gardens.

Sustainability not...

...an agriculture that wastes and loses its topsoil.

...an agriculture that is trying to support more people than its carrying capacity.

...an agriculture dependent on heavy inputs of fossil fuels.

...an agriculture that pollutes soils, waters and the air.

Conventional agriculture can do all those things and must be redesigned if it is to become sustainable.

Sharing knowledge

The First Circumpolar Agriculture Conference was held in Whitehorse in 1992. Industry, government and researchers from northern countries with similar climatic and soil situations as we have in the Yukon exchanged ideas on agriculture. By comparing and sharing information, they are better able to understand the requirements needed for sustainable northern farming.

9 The amazing world within the soil: helping us understand why sustainability makes so much sense

Most people think about the fish that live in the rivers or the wildlife in the forest, but do you ever think about what is living in the soil? Soil is not just something you stand on or pull a turnip out of. Life in the soil is a whole world in itself. Let's see if we can begin the process of uncovering these amazing secrets that live within the underworld.

Let us look at some of the soil's inhabitants and their goings-on. In most parts of the world there is more life beneath the surface of the soil than above it. As many as 1,000 different types of organisms may be found in a few shovelfuls of forest soil. Nearly all groups of animals that are not exclusively marine have representatives in the soil. Moles and gophers, thousands of species of insects, mites and their relatives (collectively called Anthropoda), smaller animals such as nematodes (roundworms and their relatives) and the one-celled protozoa all live within the soil.

Soil is living and breathing. The primary action taking place is the breakdown of organic matter and the release of plant nutrients. The organisms in the soil efficiently decompose the accumulated dead plants, animals and other forms of organic matter. Without our friends in the soil we would be up to our ears in dead animals, leaves, and other organic matter. This process of plant and animal production, death, decomposition, recycling and then back to plant production is all possible because of the living processes within the soil.

Increasingly, however, these organisms are having a harder and harder time getting their work done. Directly or indirectly, many farm production practices harm them. Pesticides and some fertilizers poison them. In addition, contamination with a vast range of pollutants adds to the hazards of life in the soil.

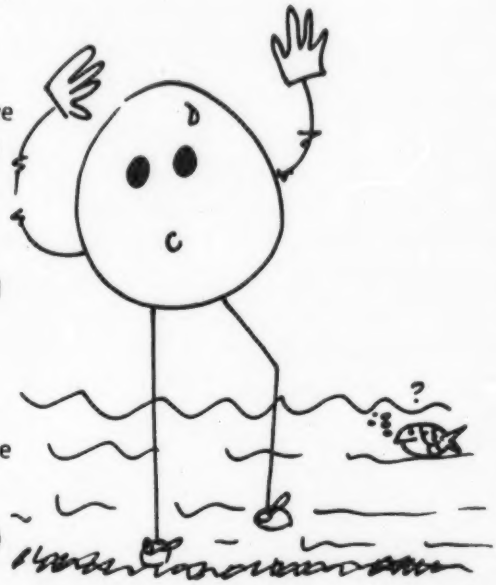
We are cutting off the hand that feeds us. The productivity of our farms and forests, and ultimately ourselves, relies upon these very organisms which provide this free decomposition service. Over half of the organic matter in prairie soils has been lost in the past 40 years, and loss from all soils is over twice the rate of new soil formation.

From a soil organism's perspective about half of the average soil consists of solid material, mostly mineral particles, and half consists of spaces between the particles. Half of the spaces are filled with water that occurs as a film around the particles. Nematodes, protozoa, and some other small organisms feed primarily on bacteria and on one another as they creep or swim around in the water film. Springtails, mites, and other small arthropods wander in the air spaces with water up to their knees. As the arthropods wander around they can be seen browsing on nematodes, fungi and one another. Earthworms, other larger arthropods, some insects and snails can be found burrowing through the soil feeding primarily on the dead organic matter and on the microorganisms that colonize it.

The key question on soil management is: What can we do to provide these organisms with optimal food and space conditions so they can get their jobs done? Clearly, the key is to allow the return of a mixture of uncontaminated organic wastes to the soil, and to avoid stressing the system chemically, biologically and physically.

Whenever we eliminate one of these organisms we inherit its job at which it is an expert and we are at best, novices; at worst, we could be totally inadequate in its role.

(adapted from *The World Under Our Feet*, by Dr. Hill)



10 Fertilizers and pesticides: a "hot topic" within sustainable agriculture

1.

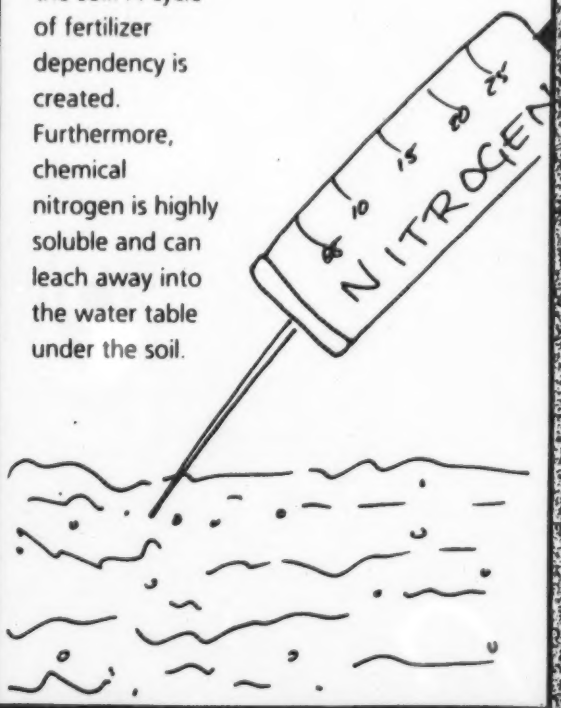
Chemical or synthetic fertilizers and pesticides have been used for soil nutrition and the management of weeds, insects and diseases. But the introduction of these synthetic fertilizers and pesticides in food production has had unanticipated negative effects. Chemical fertilizers are a quick nutrient fix for growing crops but disrupt natural nutrient cycles in the soil; land is being exhausted due to lack of soil regeneration practices and overuse of chemical fertilizers; as soil quality deteriorates, more and more additives are used to achieve adequate crop yields; certain pesticide additives have toxic or carcinogenic (cancer-causing) effects; and chemical fertilizers have caused disruption of the natural chemical balance in soils, making them less fit for certain crop growth.

2.

The nitrogen rush starts a chemical dependency in our soils

Chemical fertilizers are fast releasing, sending a rush of nitrogen to the soil. But in order to make use of the nutrients in this fertilizer, the soil microbes must take energy from organic matter. The soil becomes progressively more lifeless as the organic matter is gradually depleted.

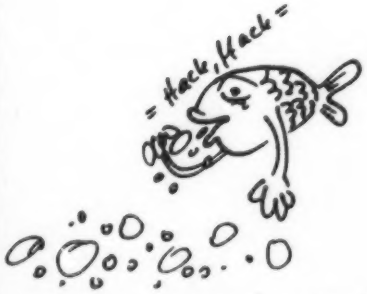
More fertilizer is needed when there is less organic matter in the soil. A cycle of fertilizer dependency is created. Furthermore, chemical nitrogen is highly soluble and can leach away into the water table under the soil.



3. Chemicals in our water

Runoff of agricultural chemicals from fertilizers and pesticides is one of the most widespread and serious of all water quality problems. The problem is most acute where fertilizer use is high.

Chemical pesticides run off into the surrounding soils and water systems. These remain in their toxic state or break down into substances that are sometimes also harmful to the environment.



Fertilizers that are not used up by the crops are washed into streams, rivers and lakes. Chemical fertilizers often contain nitrates which increase algae growth. When the algae die they decompose, which uses up high levels of oxygen and results in the death of fish and other aquatic life.

4. Fertilizer and snow don't mix

Fertilizers should not be applied when the fields are frozen or covered with snow. This can result in fertilizers entering watercourses during spring runoff.

5. The Green Plan protects our water

The Yukon government plans to protect water quality from the negative effects of livestock and possible contamination by chemicals in fertilizers and pesticides. The agriculture-food component of the Green Plan encourages water management practices that will ensure that surface water and groundwater are not unduly degraded.

6. 3,000 tonnes of fertilizer

Phosphorus promotes the growth of algae and can kill fish and other animal life by reducing the oxygen available. About 70 per cent of the 3,000 tonnes of phosphorus that enters the Great Lakes from Canada every year comes from agriculture.

7.

Pesticides also kill the good guys

Pesticides also kill beneficial soil micro-organisms and insects that may be helpful by eating pests, pollinating flowers, and actually helping crops grow. When the pests come back, the "good bugs" are no longer there to help maintain a balance. The farmer then adds more pesticides which again results in a cycle of chemical dependency.

8.

Cold weather hampers pesticide breakdown

Pesticides which do break down naturally break down more slowly in northern conditions. The warmer the soil the faster the pesticide product will break down to more natural components. In colder northern conditions the breakdowns are slower and the residues stay in the soils longer.

9.

Cancer and pesticide use

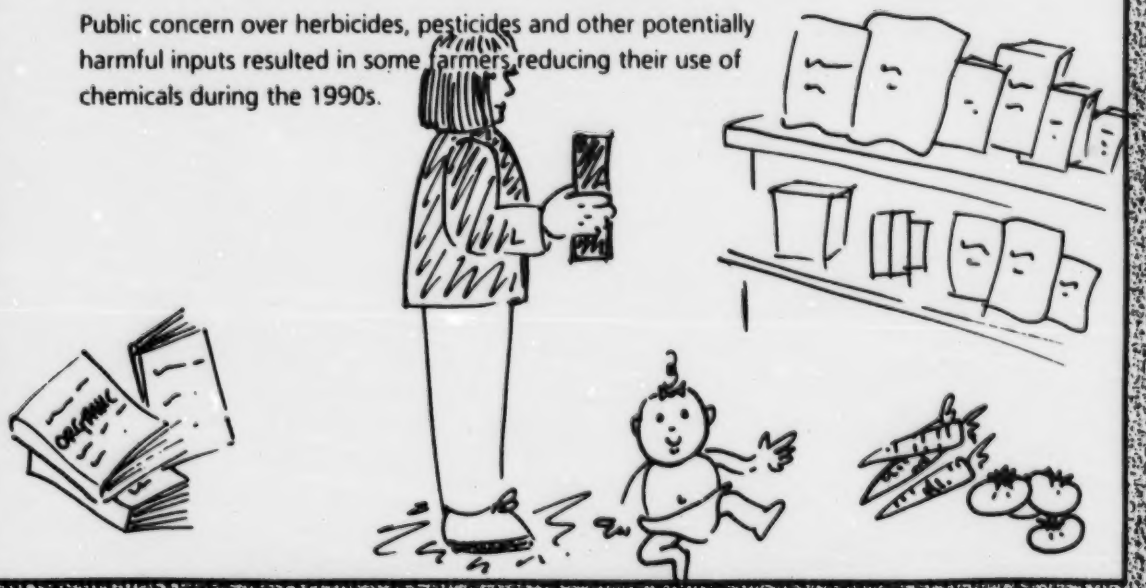
Studies show that farmers who are heavy users of pesticides have much higher incidences of cancer and other diseases than farmers who have not used such inputs. Fortunately, pesticides are not used widely in the Yukon.

10. Fertilizer use has increased in Canada but not as much as in the Netherlands

The intensity of fertilizer use in Canada has increased from 6.4 kilograms of nitrogen per hectare in 1970 to 26.1 kilograms per hectare in 1990. In contrast, in the mid-1980s France used 80 kilograms per hectare, and the Netherlands, whose fertilizer usage is the most intensive in the world, used 250 kilograms per hectare.

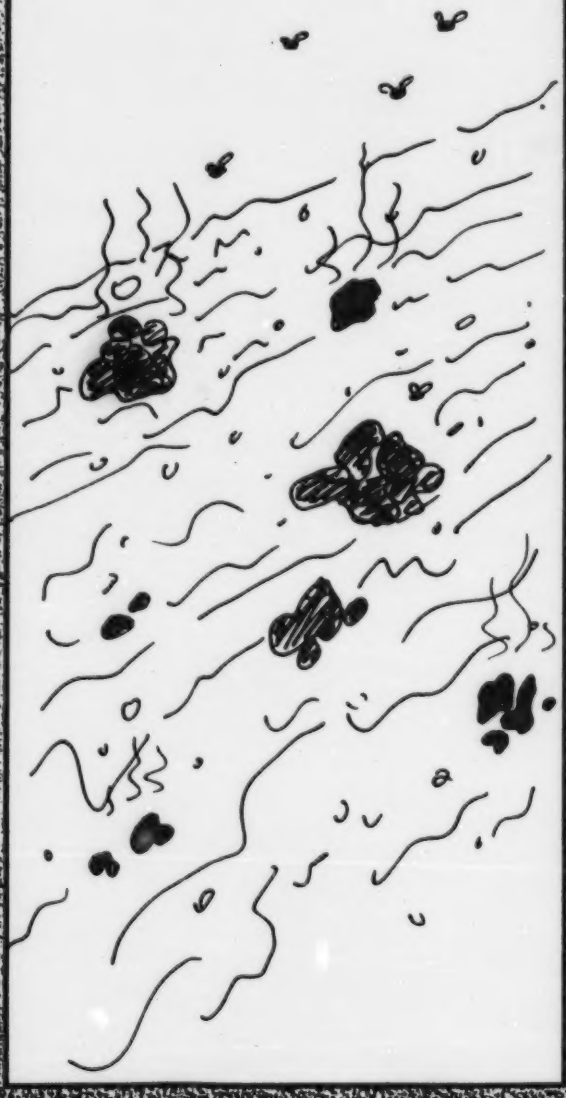
11. You have a say about those nasty chemicals

Public concern over herbicides, pesticides and other potentially harmful inputs resulted in some farmers reducing their use of chemicals during the 1990s.



12. Is it possible to grow without chemicals?

Farmers have been concerned that if they don't use pesticides and fertilizers they won't be able to produce sufficient quantities of crop produce. However, some studies show that using fewer pesticides and fertilizers may help crops grow more. Recent studies have shown fewer harmful insects on collards fertilized with manure than on those fertilized with synthetics.



13. Looking for the benign solution

The farmer who practices sustainable farming will begin to substitute the environmentally damaging products with more environmentally benign products. For example, synthetic nitrogen fertilizers may be replaced by organic sources, and non-specific pesticides by biological controls.

14. Less chemicals if it's sustainable

A conventional farm must purchase synthetic fertilizers while the sustainable farm uses animal manure, green manure and crop rotations for soil fertility. Natural fertilizers bind into the soil, remaining in the soil longer. This is compared to the synthetic fertilizer which can wash out easier into a nearby water system.

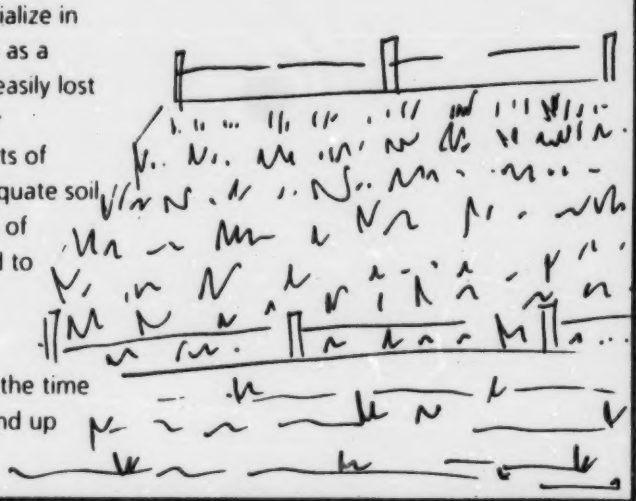
15. Yukon soils have deficiency

Yukon soils are often low in nutrients because Yukon soils are generally low in organic matter. Nitrogen is usually the most deficient and phosphorus the most available of the major elements. Of the micro-nutrients, boron has been found to be deficient in several locations. The balance of nutrients is important, as an excess or deficiency of one can affect the availability of many others. Yukon farmers can get their soils tested to see what nutrients their soils lack or have in abundance.

16.

Monocrops are not a good idea

Some conventional farms tend to specialize in one kind of crop; these are referred to as a monocrop. A monocrop can be more easily lost to adversities, such as pests, disease or weather. Because of this, large amounts of fertilizers are required to maintain adequate soil nutrient levels and regular applications of herbicides and insecticides are required to control the pests that thrive in such monocultures.



In addition, growing the same crop all the time robs the soil of nutrients—so farmers end up using more and more fertilizer.

17.

Computer assisted manure management—what next?

Modern technology has much to offer the sustainable farmer. Intensive animal farming can create a serious water pollution problem. A new computer-assisted manure management program allows users to assess the nutrient content of manure from several animal species and identify the amount of manure needed on specific farm fields. The program allows manure to be managed in a way that eliminates water pollution problems and at the same time reduces farmers' expenditures on chemical fertilizers.

11 Nitrogen fixation: plants add nitrogen to the soil naturally

❶

How do farmers fertilize without adding chemical nitrogen—one of the most essential elements in plant growth?

Nitrogen is the most common element in the atmosphere but is not in a form that most plants can use. Nitrogen can be added naturally by growing certain plants that are capable of performing the nitrogen fixation process.

❷

Transforming nitrogen from the air, into the soil—legumes do it

Conventional farming adds chemically-produced nitrogen to the soil. However, producing nitrogen chemically requires extremely high energy costs in terms of fossil fuels.

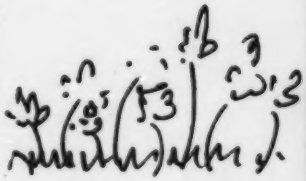
Leguminous plants such as peas, fababeans, lentils, alfalfa, and clovers have the ability to convert atmospheric nitrogen into available nitrogen in the soil. This process is called nitrogen fixation. It is the process by which gaseous nitrogen from the air is incorporated into organic nitrogen-containing compounds and, thereby, brought into the soil's nitrogen cycle. This nitrogen is released into the soil and becomes available to other plants that are growing in the farmer's field.

❸ Plow-downs create nitrogen

In the fall, farmers plow their crops under to give the soil nutrients for the next planting season. The main effect of turning under legumes is to add nitrogen-rich, readily decomposable plant material to soil. It is a process of feeding the living component of the soil. When soil organisms break down this organic material, they provide nitrogen to the soils. If nitrogen is missing plants won't grow, so this process called plow-down is essential.

❹ There is a lot of gas over those farmers' fields

Over every acre of farmland there are 35,000 tons of nitrogen gas. This form of nitrogen is unavailable to all crops except legumes. Farmers plant legumes in their rotations to keep this nutrient available to non-legume crops.

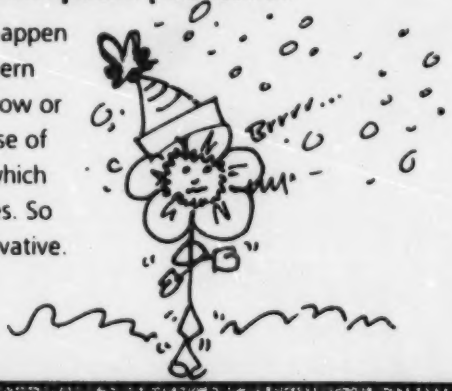


❺ Let's take a look at Alaska's fababeans

Fababeans are well adapted to conditions in interior Alaska, which are similar to what we have in the Yukon. These fababeans are capable of fixing large amounts of nitrogen. Forage oats require large amounts of nitrogen so there is considerable interest in growing interseeded oats and fababeans for forage. It would make a nice relationship of give and take, with the fababeans giving nitrogen and the oats taking the nitrogen.

❻ The cold slows down plant processes

Some processes which happen easily in the soil in southern regions of Canada are slow or non-existent here because of the cold temperatures which hamper certain processes. So farmers need to be innovative.



Nitrogen fixation is slower in the Yukon as well. Scientists are helping farmers find crops that are capable of performing this process at low temperatures. Different types of crop plants have been tested for their ability to grow at 10 degrees C and to perform nitrogen fixation.

7 Inoculation

All legume seeds should be inoculated prior to seeding with the appropriate strain of rhizobium. Proper inoculation puts rhizobium bacteria into the soil, entering the root hairs of the plants and causing nodules to be formed. Nodules are the swellings on the roots of legumes inhabited by nitrogen-fixing bacteria. These nitrogen-fixing bacteria convert atmospheric nitrogen into nitrogen compounds.

Reasons for inoculating legumes include:

- It ensures early formation of effective nodules for nitrogen fixation.
- It makes sufficient nitrogen available to the seedling soon after the seed protein supply is exhausted.
- It often increases legume yield by more than 100% on soils that are low in nitrogen and lack sufficient numbers of effective rhizobia.
- It improves the nutrient value of legumes because it results in a small increase in the protein content, particularly when they are grown on less fertile soils.

And this is what farmers mean by low cost input and high value return. By putting the right rhizobium powder on the seeds before planting the farmer gets all those good things.

8 The "colonizers" of nature

Did you know that legumes are the "colonizers" in nature. They are the first plants to invade and grow in barren areas, because nitrogen fixation permits legumes to grow in relatively infertile soil materials. After legumes have grown for several years in sterile gravels, nutrient levels accumulate to where other plants can invade and thrive.

12 Organic farming: is it sustainable?

1.

Organic is the way to go

Organic farming is now considered the best way to improve the safety and quality of food, reduce toxins in the air and water, conserve the soil and make agriculture sustainable.

2.

How to be organic

Organic farming is a system of farm design and management practices. Organic producers must follow management practices that include recycling plant and animal residues, crop rotation, water management, minimum tillage and cultivation. Soil fertility is maintained by a system which optimizes soil biological activity. This means returning nutrients and organic matter to the soil from compost, manure or crop plow-downs.

Organic food production prohibits the use of synthetic fertilizers, pesticides, fungicides, herbicides, plant and animal growth regulators, antibiotics, hormones, preservatives, colouring or artificial additives, ionizing irradiation and genetic manipulation of plants and animals.

It takes three to five years for a farmer to convert from conventional to organic practices and to have the produce be certified organic.

3.

A small is beautiful story

A southern farmer lost his farm to the bank because he could not meet payments on his loan. He was left with only five acres, which he decided to farm intensively, but organically, concentrating on producing a variety of fresh, high-quality vegetables. He used only small and appropriate technology to lower capital costs. He derived $27,000 net income from those five organic acres. This "small is beautiful" success story illustrates how we could wean ourselves from our dependence on fossil energy, large farms that grow monocultures, and chemical fertilizers and pesticides.

4.

It's juicier

Many say that organic food is juicier, sweeter and tastier.

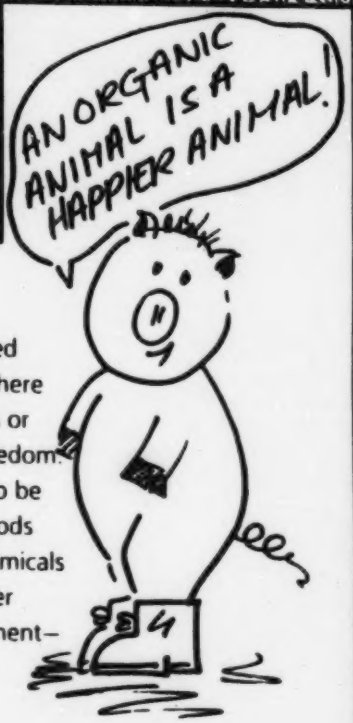
But you may have to pay double for organic produce. For example, instead of $1.00 for a tomato, you may have to pay $2.00. Do you think it is worth it?

Organic produce will become cheaper when more farmers grow it and more people buy it.

5.

How many are organic?

37% of farmers in the Yukon grow organic produce.



6.

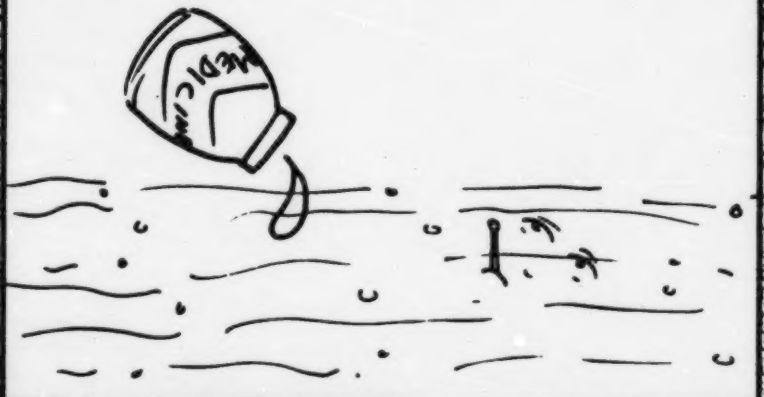
Organic meat

You can also get organically raised meat. Most animals are raised where they are packed together in pens or very small cages and have no freedom. Free-range animals are allowed to be outside and walk around. The foods these animals eat don't have chemicals added to them. That means fewer chemicals end up in the environment– and in our bodies!

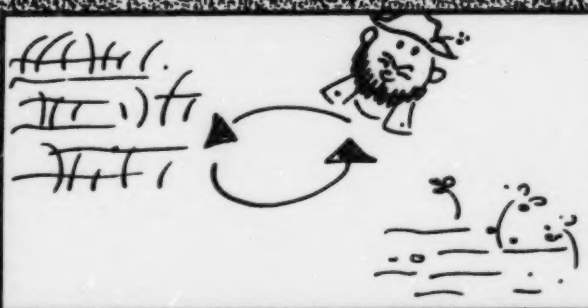
7

Imbalance on an organic farm

But even the best organic farmers can have their land imbalanced. Sometimes organically-grown crops are raised with deficiencies in elements such as nitrogen and phosphorous. Some question what farmers will do when the biological life in the soil cannot supply the necessary elements required for crop growth. Some suggest the use of non-toxic synthetic fertilizers as "medicine" to rebalance the soil.



13 Crop rotation: crop rotations are an essential tool in sustainable agriculture



Putting an appropriate crop rotation scheme in place is an important tool for sustainable agriculture. Crop rotation is the practice of planting different crops in different sections of a field each growing season. A crop rotation scheme builds organic matter, soil structure and soil tilth. ❶

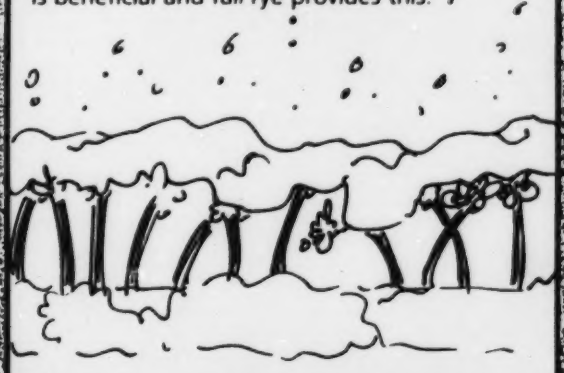
Diversity of crops builds the soil ❷

Sustainable crop rotation feeds the soil so that the soil can feed the crop. Planting a diversity of crops from different plant groups provides a varied root system, different nutrient requirements and ability to add nutrients to the soil, as well as a means of competing with weeds. Using this approach, a farmer can incorporate a green manure crop into the rotation for erosion and weed control, a crop for improving the soil physical properties, and another to improve soil nutrients.

It takes years to perfect a sophisticated crop rotation but by learning to apply the basic principles of diversity, the use of legumes, and soil building crops, a farmer has an excellent soil base on which to build.

Oats and rye ❸

In the Yukon it is best to use short rotations of oats and fall rye and plow them under. This is because these crops provide large amounts of organic matter at a reasonable cost. In the Yukon an additional winter cover is beneficial and fall rye provides this.



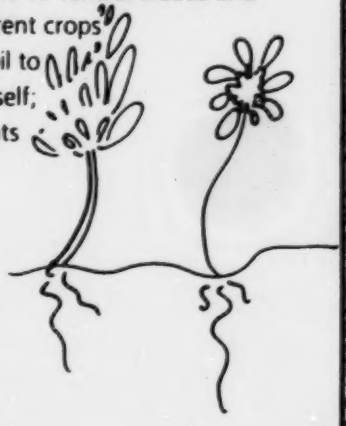
Barley crops can add nutrients and fibre ❹

A barley crop produces straw containing nitrogen, phosphate, potassium and sulphur. It is less than a legume would produce but incorporating cereal straw not only adds fibre but a little nutrient too!

Rotating crops is sustainable ❺

An appropriate crop rotation is absolutely essential to a sustainable system of agriculture.

- A monocrop (a large track of land growing only one crop, such as wheat) is not sustainable agriculture. Crop rotation is the practice of growing different crops on the same soil in different years.
- Crop rotations are required to maintain soil fertility and to control weeds and insects. Different crops enable the soil to regenerate itself; different plants provide different nutrients, organic matter, root systems and so on.

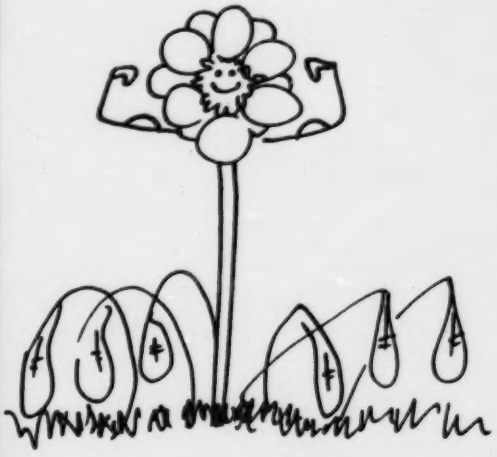


- Grasses help build soil organic matter and soil structure with their fibrous root systems. Soils under grass tend to be porous and hold nutrients and water effectively.
- Legumes are rotated because of their ability to add nitrogen fertilizer to the soil naturally. Legumes also improve the physical soil condition by penetrating soil horizons that cereal grains cannot penetrate.
- Crop rotations can be balanced to provide sufficient nutrients to the soil.
- Crops in rotation must be suited to the soil types, moisture and climate conditions on the farm.

Weed control without chemicals ❻

Crop rotation provides effective weed control by:

- including plants in the rotation that have properties of natural disease resistance
- including crops such as legumes or grasses that choke out weeds and build soil fertility
- adjusting the rotation to attack target perennial weeds
- including a range of crops that help maintain a balance of nutrients in the soil, giving a competitive advantage to the growing crop.



But no one is 100% sure ❼

No one is sure whether or not crop rotation will meet all soil fertility needs. A rotation system that achieves peak fertility is a subject being researched by scientists and farmers.

14 Soil conservation: a properly sustainable system is soil conserving

1

We don't have a problem with our soils in the Yukon like they do in other parts of Canada, so why do we have to bother with soil conservation?

You're right, farming in the Yukon has not deteriorated our soils like it has in other parts of the country. But if we don't develop proper soil conservation methods here, you can be sure we will experience a similar decline in the quality and productivity of our agricultural soils—just like they have in other parts of Canada.

Well I certainly don't want to see that. Can you tell me, what is soil conservation?

As farmers cultivate and grow crops the soil can become depleted and imbalanced. But good soil conservation practices help prevent this depletion and can actually revitalize and enhance the soil. Soil conservation practices help prevent loss, waste, depletion or harm to soil. Farmers especially need to prevent soil loss and soil erosion especially of our topsoils, which are essential to plant growth. They also need to prevent the depletion of soil nutrients, soil structure, organic matter, microbial life and anything else that makes our soils healthy.

2

Here are some statistics to prove why it's important that we practice soil conservation now

Worldwide, 25 billion tonnes of agricultural topsoil are swept away every year. That's 7% of the globe's good growing land every decade.

Between 1961 and 1976, Canada lost more than 1.4 million hectares (3.5 million acres) of farmland to urban encroachment—roughly the area of Prince Edward Island.

Estimates of the annual on-farm cost of the losses attributed to soil degradation range from $713 million to $1,064 million.

In 1985, the federal minister of Agriculture said Canada will lose the topsoil it needs to feed itself within 50 years unless current farming, land use and water practices are reformed.

60% topsoil lost—what's left?

Canadian prairies have lost 60% of their topsoil in the past 30 years. This is damaging to the environment and to the economy of Canada.

The result of this productivity due to soil loss costs Canada $2 billion annually.

3

75% of the methods used promote soil loss

Even though 25 billion tonnes of topsoil are lost around the world every year, and millions of hectares of tilled land are at risk, conservation techniques are still not being used extensively. In 1986, 75% of Canada's crops were grown using methods that promote soil erosion.

4

There is still hope for our soils in the Yukon

In the Yukon we have the opportunity to avoid soil degradation by proper soil conservation practices. We can manage our land and soil properly to ensure that our farms remain productive and sustainable. Yukon farmers are beginning to incorporate conservation measures into their agricultural operations.

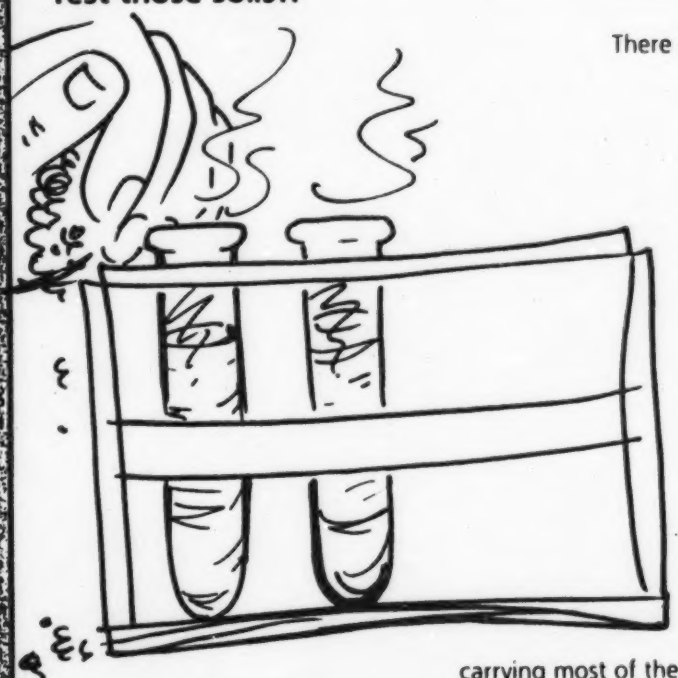
5

What is soil improvement and soil conservation?

It is adding nutrients naturally, building organics, maintaining the topsoil, maintaining and regenerating the living organisms that live within the soil, stopping erosion, developing a good layer of humus and just about anything that builds soil vitality and health.

6

Test those soils!!



There are twenty elements presently known to be essential for the growth of plants. Approximately 95% of plant nutrients come directly from air and water, and the rest come from the available mineral and organic matter reserves in the soil. Soil building programs can be established by determining what elements are missing or unbalanced.

Soils are a much more complicated system than most of us are aware of. Each element has a particular function within the soil ecosystem. For example, calcium has the job of carrying most of the nutrients to the plants. But where magnesium is high, calcium is unavailable to do its work. And copper strengthens the stalks of grain when it is in balance with other required nutrients.

7

275 million tonnes of soil lost to wind and water

Wind and water erosion remove an estimated 275 million tonnes of soil each year. Soil erosion is a natural process that will occur no matter what we do, but soil conservation will reduce the amount of erosion to a level where soil quality can be maintained.

Unprotected soils cause loss of top soil

Farmers need to till the soil. This means they need to remove all the natural vegetation and break up the soil for seeding crops. By breaking up the soil and removing the plant cover, farmers face a risk. If the soil is unprotected and large amounts of rain fall, the water can sweep away huge amounts of precious topsoil.

8

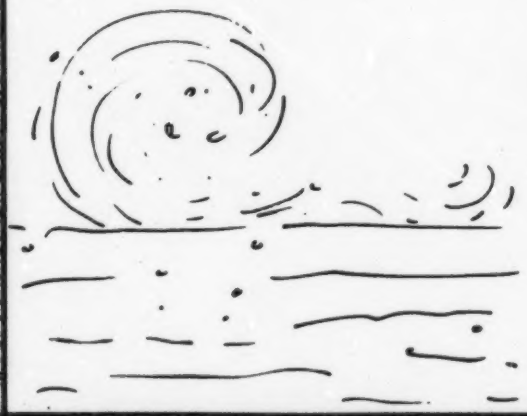
Topsoil loss could be lost more quickly in the Yukon

Continuous farming in dry areas can lead to loss of soil nutrients and moisture, increased erosion and desertification. In the Yukon we have dry summers and cold dry winters. These conditions, along with a limited amount of topsoil (much less than in southern regions of Canada), may cause soils to deplete more quickly than in other areas of Canada. Without soil conservation, huge tracks of Yukon land could be left unproductive for farming and no longer available as habitat for wildlife.

9

The main culprit

Large, cultivated but unseeded fields are the main cause of soil loss, as barren fields are easily eroded by wind and water. Maintaining a permanent crop is essential to prevent soil loss. Luckily, most fields on the Yukon farms are under perennial grass cover.



10

Safe-guards

Two safe-guards against soil erosion are vegetative cover and well-aggregated soil. A good vegetative cover prevents wind and water erosion, improves appearances, and protects streams and lakes from sediments.

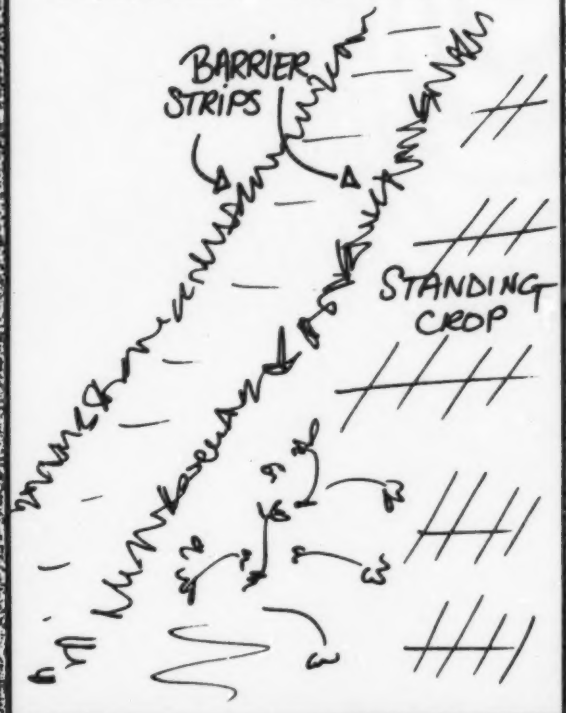
11

Barrier strips offer protection

One way to combat soil loss is to disrupt and slow surface wind patterns. A technique for doing this is the establishment of annual barrier strips. Barrier strips reduce wind velocity at ground level and thereby reduce the potential for soil movement. Properly designed barrier strips will provide protection for up to 10 times the height of the plant.

Barrier strips also help by increasing soil moisture reserves. The strips capture and maintain snow during winter months, making this moisture available to following crops. They also help reduce the amount of evaporation during both summer and winter. The greater soil moisture can protect the soil and result in higher yields in the following crop year.

Various crops are used for annual barriers. Legumes such as field peas have been used in barrier strips as they offer good resistance to insect attack and fix nitrogen for the strip.



12

Leaving the stubble

Another soil management technique is to leave standing stubble. By cutting the crop a bit higher the extra height will catch the snow and provide for more soil moisture.

13

What can Yukon farmers do to improve and conserve our soil?

1. The use of barrier strips, windbreaks, and shelterbelts to prevent wind erosion and retain soil moisture.
2. Green manuring and crop rotations to improve soil quality. Field peas, oats and alfalfa have been the crops planted and ploughed in for soil building.
3. Conservation tillage systems, proper drainage, strip and contour farming to prevent soil erosion and enhance soil structure.
4. Plow-down of grass and cereal crops to enhance soil organic matter levels.
5. Use of inoculated legumes to provide nitrogen and organic matter.
6. Forage establishment on marginal lands enhance soil quality.

14

Microorganisms to the rescue—they do more than you think

To rebuild the soil or keep the soil healthy the farmer must return organic matter to the soil. Organic matter can be added through crop plow-downs, animal manure, green manure, and crop rotations. This will add to the soil's absorbing capacity, improve tilth, and help prevent erosion and leaching.

The end product in this process is humus. Humus makes the major elements available to plants and so adds to the soil's fertility.

15

Organic matter also stimulates microbial life

The turning under of lush growing plant material greatly stimulates the activity of soil microbes. These micro-organisms break down the organic matter. The increase in soil organic matter and microbial life also improves soil structure. This means a more biologically active soil, a better water holding capacity, and faster recycling of nutrients. This all leads to better plant nutrition.

16

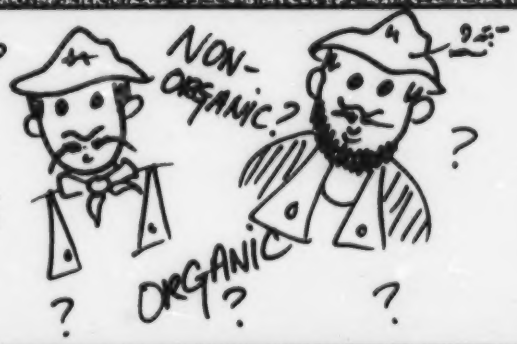
What does adding organics do?

- improves root penetrating ability
- improves water holding capacity
- makes the soil warmer because of increased biological activity
- releases a balanced amount of elements slowly as the plant needs them
- results in greater nitrogen fixation
- prevents erosion
- faster recycling of nutrients—and much much more.

17

Neighbours compare their topsoil

A study was done on two neighbouring farms that had been in operation for 40 years. The one neighbour who farmed by organically managed farming practices had six more inches of topsoil than his neighbour who practiced conventional/chemical methods.



18

Materials that rebuild

Materials that rebuild the soil are manure, crop residues, cover crops and properly composted products.

19

Roots improve soil structure

The farmer can improve soil structure and soil tilth by including deep-rooted plants and plants with fibrous root systems in their crop rotations. A balance of crop rotation in which root systems penetrate soil compaction, bringing nutrients to the surface and allowing air and water to infiltrate the soil more readily is needed. These root systems can increase soil aggregate stability, which in turn, increases water infiltration and retention improving the soil's ability to sustain plants during drought conditions. This also helps to reduce both water and wind erosion.

Grass—who would ever think...

The rooting systems of grasses help promote good soil structure. Half the total plant weight of grass plants is below the soil surface. This builds soil fibre content.

20

Yukon farmers step towards soil conservation

In 1991, twenty of 137 farms in the Yukon specifically planted crops for soil improvement purposes. A total of 325 acres was set aside for soil improvement. This is good on-farm soil management and is an important step towards soil conservation in the Yukon.

21

Healthy soils mean healthy food

The nutrient value and quality of the food chain is dependent on the soil's fertility. Biological, biochemical and chemical processes in the soil are essential to the health of the soil, plants, animals and humans.

22

Plow-downs maintain Yukon soil vitality

Farmers plow-down certain crops to add organic matter and nitrogen to the soil. Some farmers plow-down in the fall, while others wait until the spring. Plant material plowed-down in the Yukon's fall season lies in the soil over the winter, unable to break down in the cold temperatures. The advantage of a fall plow-down, is that residues are more incorporated in the soil for seeding in the spring.

On the other hand, spring plow-downs have other advantages. During the winter the standing crop collects snow and in so doing can increase the amount of moisture getting into the soil during spring break-up. However, it may delay seeding in the spring due to the plowing activities and because of the short growing season in the Yukon this could be a problem.

23

Soil conservation practices in the Yukon

1. Annual cover crops/plow-down

Annual cover crops such as rye, oats, barley, and winter wheat can be seeded for erosion control and plowed into the soil to promote organic matter build-up.

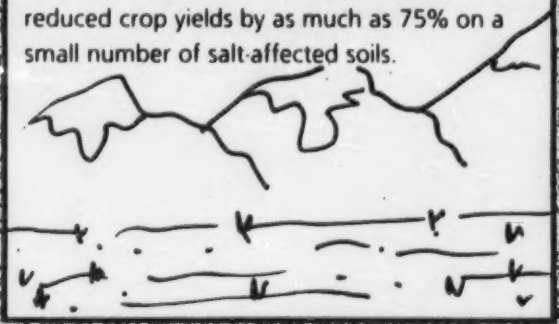
2. Green manuring/plow-down

Legume crops such as alfalfa, field peas, red alsik, and sweet clover, are grown and worked into the soil to increase the organic matter content.

24

Salinization

Some 20 million hectares of food-producing land are abandoned each year because of waterlogging, salinization, or alkalization of soils. In the Canadian Prairies, salinization has reduced crop yields by as much as 75% on a small number of salt-affected soils.

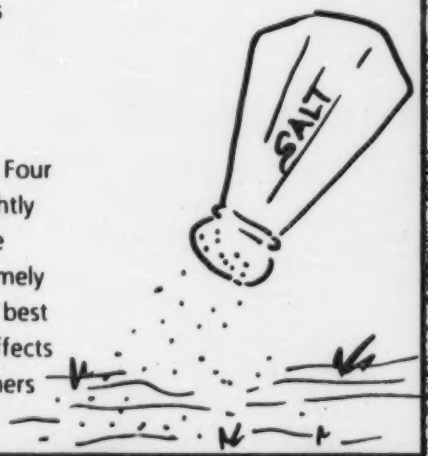


25

Salty soils

In Saskatchewan, a quarter of a million hectares of previously productive land has no crop production because of salinity. Although we do not face massive land loss due to salinity, soil salinity does occur in the Yukon and could be a significant form of soil degradation in the Whitehorse area.

In 1990 a research trial was initiated in the Whitehorse area to determine the effects of soil salinity on the growth of five crops. Four sites were selected with a range of salinity levels: non-saline, slightly saline, moderately saline and extremely saline. Crop performance was generally best on the non-saline site and worst on the extremely saline site. On all levels of salinity, bromegrass was generally the best yielding forage. These results indicate that soil salinity strongly affects forage growth and establishment. The research will provide farmers with cropping options for salt-affected soils.



26

The foundation of sustainability

Do you now understand why it is so important to develop good, healthy soils? Developing and maintaining healthy soils is the foundation of agriculture sustainability and is ultimately the basis from which all life flows. Healthy soil means healthy crops, healthy animal herds and a healthy community.

It is the farmer's task to re-establish this balance and regenerate the soil so that it may be farmed for hundreds of years into the future. These soil conservation practices of prevention, maintenance and soil building are all ways that the sustainable farmer enhances optimum soil health for you, your community and the environment.

15 Agriculture and wildlife: developing strategies to protect wildlife

1.

The Agriculture-Food Component of the Green Plan states its intention to minimize the effects of agriculture on wildlife.

You're right, the government's Green Plan does protect the environment from agricultural impacts. And that includes protecting and minimizing the impacts on wildlife habitat in the Yukon.

2.

All this wilderness and still conflicts

I'm surprised that with all the wilderness in the Yukon, that there would be a conflict between agriculture and wildlife.

Yes it may surprise many people, but there is competition between agriculture and wildlife for certain specific areas of land in the Yukon. In the territory we have a limited amount of rich valley bottom land and wetland areas which are both valuable to wildlife and agriculture. The valley bottom land is important habitat for ungulates and small fur bearers. Wetland areas are essential for water fowl migrations and nesting.

3.

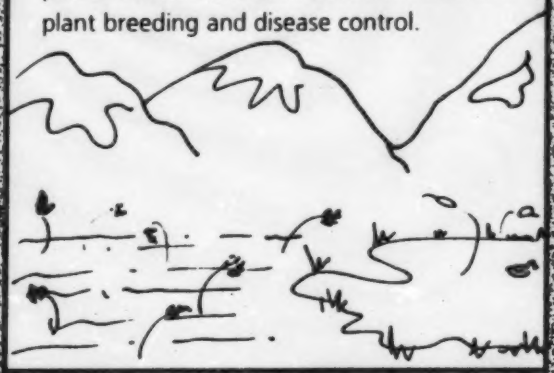
Can't the birds just go somewhere else?

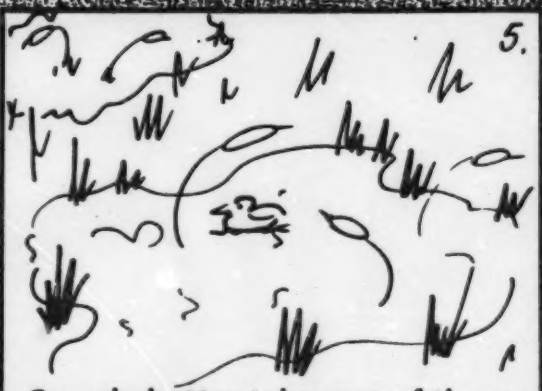
It depends on the area and if there are alternatives. Sometimes there isn't anywhere else to go, and there is only so much habitat. It is area-specific—certain areas are more crucial to maintain than others. In some particular areas wildlife have used it for thousands of years and the disruption can be devastating.

Agriculture effects habitat

4.

Five to ten per cent of the world's species risk extinction over the next decade due to habitat destruction, in part because of agriculture expansion. The threat of extinction also extends to beneficial insects and fungi, which contribute to the long-term health and productivity of agriculture through maintenance of soil quality, and as part of a tool chest of mechanisms used in plant breeding and disease control.





5.

Canada better take care of those wetlands

Canada has one-quarter of the world's wetlands. It is estimated that one-seventh of the country's pre-settlement wetlands have been converted to other uses. Fortunately, the vast majority of Canada's wetlands occur in northern boreal and subarctic environments where no agriculture is practised.

Does agriculture only compete with wildlife for land?

6.

No, agriculture can also compete with hunting, trapping, recreation, urban expansions and subsistence harvesting in the Yukon. It's not always possible to please everyone. In some instances, agriculture enhances wildlife habitats. Migrating birds utilize farm grain fields for free high quality meal. The edge-effect created along field borders creates ideal habitat for small mammals and ungulates. The trick is to balance the amount of land available for agriculture with these other interests.

First Nations concerned about agriculture

7.

First Nations people are concerned that large industrial agriculture that blocks off large blocks of land could interfere with the pursuit of their traditional activities. Agricultural land that is fenced off, restricts public access to lands or water ways, prevents trapping and hunting, or destroys prime wildlife habitat are ways in which they see agriculture as conflicting with their way of life.

However, many First Nations people realize that there must be a balance with competing land uses and are in favour of farming that minimizes these conflicts and is environmentally sound.

Game farming—it's controversial

8.

There seems to be a lot of concern about game farming in the Yukon and how it affects wildlife.

There are now 250 elk, 70 reindeer, 10 musk ox, 10 bison, along with goats, sheep, deer, caribou and wild boars being farmed in the Yukon.

There are concerns about disease transmission, wild animal survival and the testing of herd health in the game farming of these animals.

Introducing domestic animals

9.

If you introduce domestic game animals into an area that has wolves, coyotes and bears, these wild animals will naturally see the domestic game animals as a source of food. If farmers begin to lose their game farm animals to wild animals it may result in the shooting, or relocating of wild animals in the area.

Game farming could weaken wildlife populations

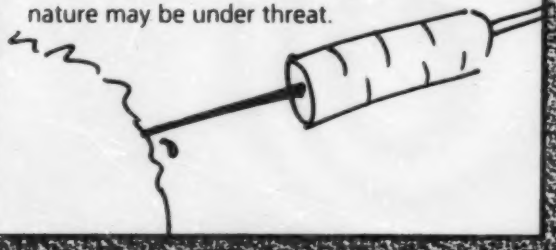
10.

There is a concern that domestic game animals could escape, infecting wild animals with diseases the domestic animals obtained in captivity. However, the only indigenous animals that could be affected in the southern Yukon are caribou who are a relative to the reindeer. All elk have been introduced and the other game animals do not occur here in the wild.

Weakening the genetic stock

11.

In many parts of the world if a domestic game animal were to mate with a wild animal it could alter the genetic stock of the wild herd. Wild animals are specially adapted to survival on the land, whereas domestic animal are used to different conditions and a different feeding regime. If these two accidentally breed, the genetic stock of the wild animal may be weakened and consequently its ability to survive in nature may be under threat.



Testing for disease in the Yukon

12.

Disease among game farm animals is always a concern. During 1991 all the farmed elk in the territory were tested for tuberculosis and brucellosis by a federal veterinarian. Luckily, all the animals tested negative. Yukon game farmers will continue to ensure that only healthy herds exist in the territory.

16 Loss of agricultural land: the greatest threat to sustainability

❶

Did you know that...

...one of the greatest threats to self-reliance and sustainability of Canadian agriculture is the loss of agricultural land. Between 1951 and 1986, over 26 million hectares (6.5 million acres) of agricultural land, approximately 12 percent of the land base currently capable of supporting agriculture, was lost to other uses.

❷

Lost to urbanization

Progress toward sustainable agriculture depends on the maintenance and security of an agricultural land base. However, farmland and farmers themselves are increasingly subject to competition from a variety of urban-related encroachments.

Agriculture is being lost to urbanization around almost all of Canada's towns and cities. 58% of the area lost to urban expansion between 1966 and 1986 was prime agricultural land. Laws and regulations to protect farmland are in place but are enforced with varying degrees of enthusiasm and political will. The land on which agriculture depends is also in demand for recreational uses, wildlife reserves, and conservation areas.

Some countries legislate prime growing areas to be maintained as agricultural land.

❸

730 million hungry

Each year 730 million people remain hungry or malnourished. In the quarter century 1975-2000, expanding cities are expected to consume 25 million hectares of cropland. Even assuming average levels of productivity, this represents the food supply for as many as 84 million people.

❹

One-third lost

At the rate agricultural lands are being damaged by erosion and poor irrigation practices, and uses other than farming, it is predicted that in 20 years close to a third of the world's arable land will be unsuitable for growing crops. If the rate of loss continues, it will likely result in famines and human misery in many parts of the world on a scale never before known in human history.

Glossary of terms

abattoir: a slaughterhouse.

companion cropping: any two crops that chemically, biologically and physically benefit each other.

contour farming: plowing the fields to the contour of the land. This prevents soil erosion.

cover crop: a crop planted on a cultivated field to reduce soil erosion or add nutrients to the soil.

crop: any plant grown for feed or fodder. This is any cultivated produce such as vegetables or hay.

crop rotation: the system of planting a diversity of crops.

forage: food for horses or cattle.

green manure: a growing crop that is plowed into the soil to enrich it with organic matter.

humus: highly decomposed organic matter in the soil.

inter-cropping: two crops seeded at the same time.

microorganisms: any organisms too small to be seen by the naked eye, such as a bacteria.

monocrop: one single type of crop. For example, an uninterrupted field of wheat.

monoculture: cropping system whereby large tracts of land are seeded to only one crop type year after year.

plow-down: the plowing under of crops for the purpose of adding nutrients, fibre and organic matter.

residues: what is left after a part of the plant is harvested. That part which is left on the field is referred to as residue.

rhizobium: bacteria that form the nodules that perform nitrogen fixation.

manure: excrement of animals, can be used for fertilizer.

strip farming: any strip of crop. For example, a strip of grass may be planted with another crop to help prevent soil erosion.

tilth: the physical condition of cultivated soil.

17 Hands on activities: putting together what we know about sustainable agriculture in the Yukon

ACTIVITY SUGGESTIONS

1. Research how the concept of sustainability is applied to forestry, fisheries, water resources and mining.
2. Write a short article for an imaginary farming magazine. Explain the importance of sustainability and how to achieve it.
3. Have a class debate or write essays on the pros and cons of farming in the Yukon, conventional fertilizers vs. organic, game farming, sustainability in the Yukon, and so on.
4. Create a documentary, essay or newspaper article on what happens if farmers do not practice sustainability.
5. Discuss what supports are needed for a successful farming industry.
6. In groups of five, have the students create two machines using their bodies' movement, words or sounds. These movements and sounds are repeated over and over again like a machine. Ask students to first create a conventional farming machine and then a sustainability machine. (Start with a donut or cookie machine so they get the idea of building a machine.) It will be challenging to create something dealing with concepts.
7. Research farming practises, sustainability, soil chemistry, and plant adaptations in cold weather climates. Discuss these issues as they specifically affect farmers in the Yukon.
8. Research the plant processes involved in nutrient up-take from the soil.
9. Research soil organisms and their functions. Collect soil samples and identify organisms under the microscope.
10. Using a territorial map, ask students to choose a piece of land as if they were applying for an agriculture land title. Students can act as a committee to decide if this piece is suitable for approval. Aspects to consider include: transportation network, land claims, profitability, location to market, arability, soil suitability, topography, access to water, location, zoning, land use conflicts with wildlife, fisheries, and recreational uses.
11. Set up an agricultural land conflict meeting. For example, a farmer who disturbs recreation or a wildlife area near the Whitehorse area. Students could take on the roles of biologists, farmers, First Nations people, local residents, environmentalists, land use officials and so on.

12. Set up experiments that demonstrate how certain farming practices affect soil erosion. Fill four pans with dirt to represent different farmers' fields:

    - Pan 1: grow grass or wheat seed to about one inch (acts as a cover crop)
    - Pan 2: leave as untouched soil (acts as a cultivated field with no seeding)
    - Pan 3: create mounds (hills) and with fingers make cultivated rows that follow the contours of the mounds (this represents contour farming)
    - Pan 4: create mounds and with fingers make rows straight across from one side of the pan to the other (this represents the conventional plowing method)

    Then tip pans on their sides and pour water over the pans with a sprinkling can to compare soil erosion.

13. Marketing is very important. How would you market Yukon produce? Write up a strategic plan and a pamphlet that would promote Yukon agriculture.
14. With a partner, design a dream farm that is based on sustainability. Indicate what practices or in-puts are occurring. Create a chart or list to outline necessary practices.
15. Review what is occurring agriculturally in other parts of the world, such as in the Brazilian Rain Forest. Consider the local and global implications of those activities.
16. Divide the class into groups of four or five students. Ask each group to develop a television commercial on sustainability.

SUSTAINABLE AGRICULTURE: EXPLORED THROUGH DRAMA

The Story of Hapson

The following is an educational dramatic role-play that enables students to apply the concepts learned about sustainable agriculture. It also provides the opportunity for more in-depth study into specific topics studied in your classroom.

Note to the teacher: For teachers who do not want to use drama in their classrooms, there are activities within the role play that can stand on their own and do not need to involve drama. These activities are: 3, 6, 7, 10.

What is educational drama? It is a powerful activity-based method of learning. It engages the entire class in dramatic activity. As the students involve themselves in the drama, they explore consequences of their choices, understand the views of others, solve problems, and investigate the impact of their actions and decisions on others and their environment.

"Teacher talk" is only an outline for the teacher. The wording can be altered to your teaching style.

Introduction

Teacher talk

"Have you ever worked on a farm? Which one? What type of farm was it? Was it sustainable or do you know? Have you ever wondered what it is like to be a farmer? In a dramatic role-play you are going to have a chance to do that. You will have the opportunity to design a farm and make decisions about various issues a farmer might face."

Teacher reads the following news clipping (although fictional, it is read as a true article).

"The town of Hapson and its agricultural industry face some very serious problems these days. At the present time, the farmers of Hapson support the town itself and the surrounding area with their agricultural products. Farming activity has occurred in the area for generations, yet this community is in serious risk of losing its farms and the lifestyle agriculture brings to the people who live there.

Hapson is not alone in its struggle; this problem is part of a trend that is occurring all over North America. Loss of topsoil and the expansion of urbanization are the main contributing factors."

Teacher talk

"The article continues, but I will stop there.

The drama we're creating takes place in Hapson. We will try to solve the problem in this community by working "in role." When we work "in role" we think, feel and have the attitude of people within the drama—in this case the farmers and other people who live in the community of Hapson. When in role you speak as if you are someone other than yourself; that is, from another person's point-of-view. I will let you know when to go in and out of role. Will you agree to do that?

In a role drama we let the drama unfold as class members offer information. Everything is accepted and built into the story, no one can negate it unless he/she have a real problem with the idea. The drama is a collective. If someone says too much or tries to create the story completely on her/him own, then we lose the collective experience."

ACTIVITY #1—DESCRIBING THE FARMING

- Divide the class into groups of 4. Each group represents a farm holding. The group can either be a business partnership or a family partnership (this may be a group of siblings or a traditional family).
- Provide each group with the brief description of a farm situation provided below.

Farm descriptions

Group #1: In the last two years you have been interested in sustainable farming. You are trying to learn more and more about this way of farming. You are the ones educating Hapson about sustainability.

Group #2 and 3. Your group uses conventional practices on your farm but are willing to consider some sustainable practices. There are certain members of your group who are very knowledgeable and supportive of sustainability.

Group #4. Your group uses conventional farming practices on your farm. Although you know a lot about sustainability, you think it is too costly to use on your farm.

Group #5, 6 and 7. Your group strictly uses conventional practices on your farm. You have not heard about sustainability.

Task (This activity is done out of role)

Ask students to decide the roles that individuals will take in each group, and their relationships to each other. (For example, an individual may take on the role of Jack, who visits each summer from Vancouver to help his older brother on the farm)

Ask each group of students to answer the following:

- What are your personal beliefs about farming practises?
- Why are you in the farming business?
- How big is your farm?
- How many years has your group been farming?
- Do you farm with synthetic fertilizers, insecticides and herbicides. Do you use large quantities?
- Do you have soil tests completed on your holding?
- Do you follow the soil test recommendations?
- Do you irrigate, and how?
- What do you grow?
- Do you have livestock?
- Do you make a complete living from farming or do some in the family/group work off the farm?
- Does everyone in the group like farming?
- Was this farm passed on from the grandparents or did they begin it themselves?
- Do you have any specific problems/conflicts with your farming operation and the environment?
- How close are you to other farms, urban areas, town, industrial areas, homesteads and so on?

When students have completed the above questions:

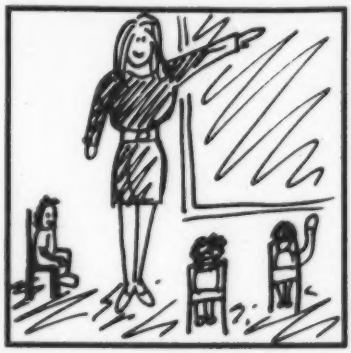
- Ask students to give their farm a name and draw a symbol that represents their farm. This symbol was originally drawn by their ancestors. Although it is kept hidden, it should remind them of the hard work their family has done over the years.

- Ask students to draw a diagram of their farming operation. This should include buildings, crops, water sources and so on.

Once each group has completed the above:

- Ask students to design (as a class) the Hapson community on a large piece of newsprint. Include the location of the individual farming groups, Hapson city center, surrounding communities, lakes and rivers, industrial areas, parks and wilderness areas, urban areas, homesteads, roads and so on.

ACTIVITY #2—HAPSON FARMERS' MEETING



- Have students set up a meeting hall. Ask students to place chairs in a format that they view as a collective. In a collective, no one person holds the power.
- Have students sit in chairs ready for a farmers' meeting. Once seated, the students should be in-role.

Teacher in role: (Teacher will take on the role of a farmer who is bringing some news to his fellow farmers. The teacher who is in role does not need large gestures or a dramatic stage delivery. Seriousness and commitment to the drama is what's important.)

"Welcome fellow farmers to the first farming meeting of the year in Hapson. I realize it's a bit early to have a meeting but I have something very important to discuss with you this evening."

As you know, there has been a lot of talk about the terrible state of farming in the Hapson area. We are not alone in this—other farmers have lost a lot of their land—many have sold out. Statistics are showing that the Canadian prairies have lost 60% of their topsoil in the past 20 years and worldwide 25 billion tonnes of agricultural soil are being swept away each year. Soil degradation and soil loss are costing Canadians millions and millions of dollars each year. It is hard to keep up financially and if we don't do something soon, we are going to lose everything this community was built on.

Testing has been done on our soils and it shows Hapson farmers may have only 10 -15 years left for growing. Some projections indicate that there is even less time available. Let's face it, some of you are already losing money. And the high costs of fertilizers, machinery—it's all getting to us. If the community is going to last, we must change.

The bank is planning to fold some of you this year. A big investor wants to buy us out. He won't tell us what he plans to do with the land, but malls, apartments and a Hapson amusement park are in the wind. You are holders of farm land that has been in your hands for generations and if this land is developed it will never be available as farm land again. So it's up to you—what do you want to do?"

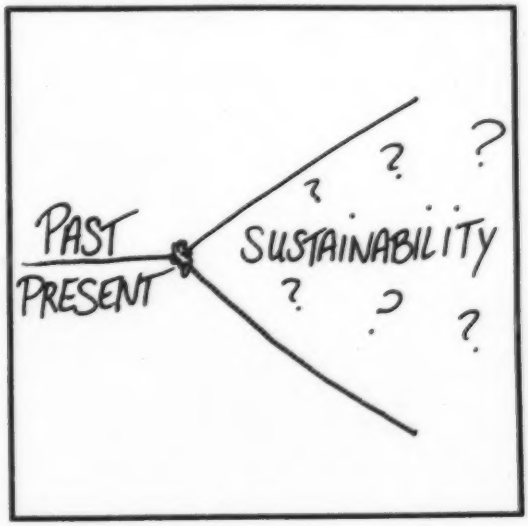
Task: Teacher and students in role carry on a short discussion about the issues in Hapson.

(At any time during these activities the teacher can ask the students to go out of role to reflect on

what is happening in the drama, to reflect on what decisions are being made, for general discussion, or to ask if everyone is clear on what everyone is doing.)

***If the teacher is limited by time, they may select one of activity 3 or 4 and then continue with activity 5.*

ACTIVITY #3—TIME LINE (Optional)



Teacher talk

"We are now at a critical point in agriculture at which we could move towards sustainability, or maintain the same farming practices we have used over the past 50 years. Let's create a time line that looks at farming in the past, and how it may evolve in the future."

- Divide the students into groups of 4
- Ask each group to draw a straight horizontal line beginning on the middle of the left-hand side of a large sheet of newsprint. Half-way across the page, the line should divide in two, extending both upward and downward. The line drawn will look like a sideways Y.
- Ask students to create a time line that represents agriculture in the past and the future.
- Ask students to indicate on the horizontal line (which represents 50 years ago and up to the present), farming practices over the last 50 years. Students should also write down the results of these farming practices on their time line. This can be depicted through phrases, pictures or symbols.
- Ask each group of students to indicate on the *upper* diagonal line (after the point which represents the present) what they believe will happen if *sustainability is not adopted* by farmers.
- Ask each group of students to indicate on the *lower* diagonal line (after the point which represents the present) what they believe will happen if *sustainability is adopted* by farmers. These may include global predictions.

(Students can use magazines to add pictures to their time lines.)

In groups ask students to discuss (these questions can be simplified for the lower grades 8 - 10):

- Share with a partner what you saw in the time lines. What do you now understand about Hapson and its agriculture problem?
- Discuss how our societies' values are reflected in farming practices.
- There is a movement towards sustainability. What does this say about society and its values?

ACTIVITY #4—TAKING THE RISK (Optional):

Teacher talk

"Even though 25 billion tonnes of topsoil are lost around the world every year, conservation techniques are still not being used extensively. In 1986, 75% of Canada's crops were grown using methods that promote soil erosion. Lets take a look at why this might occur."

- Ask students to get in groups of 3
- Ask students to label themselves A, B and C
- Tell C, he/she is a farmer who finds it difficult to adapt to sustainability. C is afraid of the risk because of financial difficulties he/she is experiencing.
- Tell A and B they believe in sustainability and perceive the risk as worth it. They both try to convince C of its benefits and the importance of taking the risk.
- Ask students to decide where this scene would take place.
- Tell students to do an improvisation while in role. It is not planned out; it is a spontaneous dialogue.

When improvisation completed

- Ask all As and Bs to stand. As teacher, you will go from student to student (As and Bs) and asks questions such as: How did your partner respond to the request for change? What were their main concerns with switching to sustainability? Did he/she understand the concept? What information did you use to convince them of sustainability? Did you get a good enough answer or do you think this requires further research? (You will build on what each student says as you go around the circle).
- Ask all Cs to stand. Ask the Cs questions that pertain to their role.

There are many things we realize need to be changed and yet they aren't. Discuss with students the difficulty of change in sustainable agriculture.

- Ask students to explore in pairs what they know about change and the resistance to sustainable agriculture.

ACTIVITY #5—MAKING A DECISION:

- Ask students to get into their farming groups. Have them sit in chairs with one empty chair placed on its own outside the circle, and faced away.

Teacher talk

"As a group you are meeting to decide what you will do about your farm in these difficult times. As you discuss your conflict be aware of the imaginary person sitting in the chair. This person is a grandparent who has handed down the farm to you. They are too old to listen or have just dozed off, so are there in the background. Take a moment to look at that person (the chair) and think of all their dreams, hard work and expectations for the future of the farm land."

- Ask students to choose one person from each group to report on what they plan to do. (Hopefully the majority will agree to keep their farm and attempt sustainable practices.)

Teacher talk

"The people in the community depend on each other. If one farm leaves now it could mean all of us lose out. I am pleased so many of you have chosen to adapt to a sustainable system."

ACTIVITY #6—PROBLEM SOLVING:

- Ask students to get into their farming groups. They will need paper and a pen.

Teacher talk

"Thank-you for attending our meeting today. Now that we have all agreed to become sustainable and work towards keeping our community healthy, we must begin to solve some very pressing problems. Most of these problems you will recognize as occurring on your farms. There may be some issues that do not pertain to your farm, but I would appreciate your consideration on these issues so that you can offer suggestions and expertise on these problems."

a) Loss of topsoil is at the top of our list of problems. Can you list what types of things you could do to solve this problem on your farm?

b) Monocrops have been a disease problem for years. They are requiring more and more pesticides and fertilizers. What new options are you planning?

c) Heavy rains are washing a lot of nitrates and phosphorus into our water systems. What are some of the problems that result from this and what solutions do you suggest to help combat this problem?

d) Our soils are low in nitrogen. What solutions are there to deal with this problem?

e) Many people are concerned about disease transferring from game farm animals to our natural animals. What concerns are you aware of regarding game farm animals and what solutions do you see available to address this problem?

f) Recent tests show that crops are lacking in nutrient value. Certain amino acids and minerals are missing and out of balance. What can be done about this?

g) Organic farmers in the area are concerned about a farmer spraying pesticides. Is there anything you could suggest an organic farmer could do in this situation?

h) Long, cold winters and short growing seasons has always been a concern in the Yukon. What can be done to help in these conditions?

i) Farmers' production costs are getting too high. Are there any solutions available to them?

j) First Nations' traditional hunting land and agriculture are in conflict over land. What suggestions can be offered to help solve this conflict?

k) There is an ideal farming area near a waterfowl nesting site. Nesting birds will be disturbed if the farmer develops near their habitat. What solutions can you suggest regarding this land use conflict?

l) Make a list of 10 things a farmer can do to make his/her farm sustainable.

Teacher talk

"I realize that many of you have been dealing with some really serious problems. This conference session is designed for you to exchange ideas that you can take home and share with your communities. Let's go through these problems one by one and see what we can come up with."

- Discussion.

ACTIVITY #7—PRESENTING RESEARCH (Optional)

(This is an optional activity that requires some advance research)

Ask students to research various topics related to farming and present it at a mock conference for the Hapson farming community. Students would act as research scientists. Topics may include subjects such as fertilizers—problems and solutions, adaptations of plants to cold climate conditions, soil chemistry, farming in other parts of the world, sustainability on a global level, soil erosion—problems and solutions, effects of farming on lakes and rivers, livestock farming, and so on.

ACTIVITY #8—LOOKING INTO THE PAST AND FUTURE (Optional)

This activity uses sit-down drama to explore agricultural issues. It involves two or three students doing a scene while the rest of the class listens. Each new scene uses new students to play out the characters. Sit-down drama uses talking and no action—students remain seated. Each scene may take from two to ten minutes.

- Have students sit in a circle.
- Ask for two or three students to volunteer for the scene. (The next scene will involve a new set of students).
- Ask students to select a scene and the characters in it.
- Have students outside the circle provide a first line to start them off—this is optional.
- Tell students the scene is an improvisation and not pre-planned.
- Stop the scene when you feel it is complete.
- Ask students to recap what they have learned at the end of the scene.
- Move to next scene.

Possible scenes (These scenes can move into the past and the future in any order)

- Discussion between a farmer and a store owner who buys produce from outside the community.
- Chemical fertilizer company representatives talking about sustainable practices.
- Fifty years into the future if Hapson farmers are not sustainable.
- Fifty years into the future if Hapson farmers are sustainable.
- Scene between a farmer who wants to become sustainable with another farmer who doesn't.
- Environmentalists, First Nations and farmers discussing a land conflict.

* It is essential that the kids involved in these role drama scenes know their information from the booklet.

ACTIVITY #9—CREATING THE SUPPORTS (Optional)

A technique called "sculpture" can demonstrate what supports are needed for sustainability to be successful. Sculptures are made by students forming themselves into a statues that demonstrate thoughts or action. Students will build one large sculpture or still picture through their bodies. The sculpture may involve six to twelve people in the sculpture with the rest of the class observing. Everyone in the sculpture stays frozen until it is completed. If students feel the need to change or modify a part of the sculpture, they can do so.

- Ask students to stand in a circle.

- Tell students they will demonstrate the barriers to sustainability–the reasons why it is not occurring in Hapson (and/or in all parts of Canada).
- Ask students to one at a time go into the center of the circle creating images of what they see as creating the road-blocks to sustainability. Students in the sculpture could include the government (local and federal), farmers, the public, retailers, wholesalers, and others who are involved in the agriculture industry. Students may also show ideas such as the exchange of ideas or lack of public support. For example, lack of knowledge can be shown by a student looking puzzled. Lack of financial support can be shown as pulling out their empty pockets, and so on.

- Ask students to discuss in pairs and then as a class what they have seen.
- Ask students to repeat the same sculpture.
- Ask students outside the circle to change the sculpture removing the barriers and demonstrating successful sustainability. For example, communication or financial support may be demonstrated by facing one another and shaking hands.
- Ask students to discuss what they have seen.

ACTIVITY #10—DRAWING AN IDEAL FARM

As a class draw the ideal sustainable farm. Use words to indicate the various activities that are taking place. A list on the side that indicates what goes on at the farm may be useful.